

CLAIMS

1. A method of conveying items using a system comprising conveyors and at least one article storage arrangement,
- 5 (a) loading items onto trays at at least one loading station of a first conveyor, each item being identified and assigned to a destination belonging to a group of predefined destinations, to thereby create articles, each article consisting of a tray carrying at least one item,
- (b) conveying articles in the first conveyor, the first conveyor being capable of
- 10 conveying articles from the at least one loading station to an article storage arrangement comprising a plurality of storage units in each of which a plurality of articles may be stored,
- (c) moving at least some of the articles from the first conveyor into storage units of the articles storage arrangement,
- (d) determining to which set of articles belonging to a predefined group of sets each of
- 15 said articles belongs according to the destination of the at least one item of the article, at least one of the plurality of storage units being assigned to each of said sets,
- (e) storing each article in one of the at least one storage unit being assigned to the set to which the article belongs,
- (f) allocating at least one discharge station of a second conveyor,
- 20 the second conveyor being adapted to convey articles from the article storage arrangement to the at least one discharge station, to a destination belonging to the group of predefined destinations,
- (g) moving at least some of the articles stored in the article storage arrangement and being assigned to said destination from the storage units and to the second conveyor,
- 25 (h) conveying said articles in the second conveyor to said discharge station, and
- (i) discharging the items from the trays of said articles at said discharge station.
2. A method according to claim 1, wherein substantially all of the articles are entered into
- 30 the article storage arrangement in step (c).
3. A method according to claim 1 or 2, wherein at least some of the predefined sets of articles solely comprise articles of which the items are assigned to the same destination.

4. A method according to any of claims 1-3, wherein substantially each of the destinations has a scheduled departure time associated with it and at least some of the predefined sets of articles solely comprise articles of which the items are assigned to destinations having a scheduled departure time within a predefined time range:
- 5.
5. A method according to claim 4, wherein the predefined time range of any of said sets does not overlap the predefined time range of any of the other of said sets.
6. A method according to claim 3 and according to claim 4 or 5 further comprising the steps
- 10 of
- (j) assigning at least one of the plurality of storage units to a predefined set of articles solely comprising articles of which the items are assigned to a given destination,
- (k) moving articles of which the items are assigned to said destination from the at least one storage unit assigned to the set of articles of which the predefined time range includes
- 15 the departure time of said destination to the at least one storage unit having been assigned in step (j):
7. A method according to any of claims 1-6, wherein the step (f) is a temporary allocation to a destination during which a subset of a total expected number of items being assigned to
- 20 said destination is discharged at said discharge station, the subset being selected from the items stored in the article storage means.
8. A method according to claim 7, wherein an operation of discharging the total number of items for a given destination comprises a plurality of temporary allocations of one or more
- 25 of the at least one discharge stations.
9. A method according to claim 7 or 8, wherein, subsequent to the discharging, the whole subset of items is stored in one container means for containing items.
- 30 10. A method according to claim 9, wherein a control means associated with the system produces an output comprising data that are significant for the identity of each of the items within the subset of items.
11. A method according to any of the preceding claims, wherein substantially each of the
- 35 storage units of the storage arrangement is designed for permitting a plurality of articles to

be disposed aligned in abutting proximity to each other longitudinally along a generally horizontally elongated storage bay, each storage unit comprising a frame defining said storage bay and support means for supporting the articles to be stored in the storage unit.

5 12. A method according to claim 11, wherein the support means of each of the storage units are arranged slightly downwardly inclined towards a front end in the longitudinal direction of the storage bay of said storage unit so that articles stored in the storage unit will be drawn towards said front end by the force of gravity acting on the articles, each of the storage units further comprises

10 movable stopping means that may be positioned so that the stopping means of said storage unit prevent articles stored in said storage unit from passing the front end of the storage bay of said storage unit, and

means for moving the stopping means of said storage unit between a position where the stopping means prevent articles stored in said storage unit from passing the front end
15 of the storage bay of said storage unit and a position where the stopping means allow articles to pass said front end,

wherein the storing of an article in a storage unit according to step (e) comprises the steps of

(e1) moving the article to the front end of the storage unit,

20 (e2) in case a previous article already resides in the storage unit, placing the article in abutting contact with the previous article so as to prevent the previous article from passing the front end of the storage unit when the stopping means are moved to the position where the stopping means allows articles to pass said front end,

(e3) moving the stopping means of the storage unit to the position where the stopping
25 means allow articles to pass said front end,

(e4) moving the article into the storage unit by means of pushing means whereby the previous article is moved further into the storage unit, and

(e5) moving the stopping means of the storage unit to the position where the stopping means prevent articles from passing said front end,

30 and wherein the removal of an article from a storage unit according to step (g) comprises the steps of

(g1) engaging the article being in a front end position at the storage unit with withdrawing means so as to prevent the article from passing the front end of the storage unit when the stopping means are moved to the position where the stopping means allow articles to pass

35 said front end,

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(g2) moving the stopping means of the storage unit to the position where the stopping means allow articles to pass said front end,

(g3) moving the article from the storage unit by means of the withdrawing means whereby one or more possible further articles present in the storage unit are moved further towards the front end of the storage unit, any article being in abutting contact with the article that is moved from the storage unit being moved to the front end position of the storage unit, and
(g4) moving the stopping means of the storage unit to the position where the stopping means prevent articles from passing said front end.

10 13. A method according to claim 11 or 12, wherein a plurality of storage units are arranged in a storage rack in at least two vertically spaced generally horizontal levels, said storage units being arranged so that the longitudinal direction of the storage bays of said plurality of storage units are substantially parallel and so that the front ends of the storage bays of said plurality of storage units are arranged in substantially the same vertical plane.

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14. A method according to claim 13, wherein the storage rack comprises
elevating means for moving articles between the at least two horizontal levels,
shifting means for moving articles in a horizontal level, the shifting means being
arranged in a vertical plane substantially parallel to the vertical plane of the front ends of
20 the storage bays of said plurality of storage units,

first transferring means for transferring articles between the elevating means and the shifting means,

second transferring means for transferring articles between the elevating means and the first and the second conveyor,

25 loading means comprising pushing means for loading articles from the shifting means into the storage units, and

unloading means comprising withdrawing means for unloading articles from the storage units onto the shifting means,

so that step (e) of moving articles from the first conveyor and to each of the plurality of
30 storage means arranged in the storage rack and step (g) of moving articles from each of the plurality of storage units arranged in the storage rack and to the second conveyor may be performed by means of the elevating means, the shifting means, the first transferring means, the second transferring means, the loading means and the unloading means of said storage rack.

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- 15: A method according to any of the preceding claims, wherein each article is labelled with a unique, automatically readable identification mark and the system comprises reading means for reading the identification marks and producing an output accordingly, the reading means being situated at least at one position along the path of the articles, the
- 5 method further comprising the steps of
- reading the identification marks of substantially each article passing each of the at least one reading means,
- producing an output from the reading means according to each of the identification mark read, and
- 10 communicating said output to the control means of the system.
16. A method according to claim 15, wherein an identification mark is placed on the tray, and the control means comprises a central control unit comprising means for storing and retrieving data concerning the identity of each of the items being conveyed by the system
- 15 and data concerning the identity of the tray on which each of said items is placed on.
17. A method according to any of the preceding claims, wherein the system comprises a separation unit arranged so that articles are transferred to the separation unit from the first conveyor and articles may be transferred from the separation unit to the second conveyor
- 20 or to the article storage arrangement, the separation unit comprising means for transferring a given article from the separation unit to either the second conveyor or the article storage arrangement depending on the identity of the article, said means being controlled by the control means for controlling the operation of the conveyor system.
- 25 18. A method according to any of the preceding claims, wherein the first and the second conveyors each comprises a plurality of conveyor sections arranged in series, each given conveyor section comprising a control unit and data communication means, data relating to the identity of an article that is passing from the preceding conveyor section to the given conveyor section being communicated from the control unit of the preceding conveyor
- 30 section to the control unit of the given conveyor section by the data communication section of the preceding conveyor section.
19. A method according to claim 17 and 18, wherein the separation unit comprises a control unit and data communication means, the data communication means being
- 35 adapted to communicate data relating to the identity of an article that is passing from the

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preceding conveyor section to the separation unit from the control unit of the preceding conveyor section to the control unit of the separation unit, the data communication means further being adapted to communicate data relating to the identity of an article that is passing from the separation unit from the control unit of the separation unit and to either
5 the control unit of the adjacent conveyor section of the second conveyor or to a control unit controlling the article storage arrangement, the control unit of the separation unit being adapted to control the means for transferring a given article from the separation unit to either the second conveyor or the article storage arrangement.

10 20. A method according to claim 19, wherein the separation unit comprises data communication means for communication data regarding whether a given article is to be transferred to the article storage arrangement or to the second conveyor from the central control unit and to the control unit of the separation unit.

15 21. A method according to any of the preceding claims, wherein the system comprises an X-ray unit for X-ray screening the items conveyed by the system and a diversion unit for receiving rejected articles, said X-ray unit being arranged so that articles pass the X-ray unit when being conveyed by the first conveyor, the X-ray unit comprises means for diverting articles to the diversion unit depending on the result of the screening, the
20 operation of said means and of the X-ray unit being controlled by the control means for controlling the operation of the conveyor system.

22. A method according to any of claims 18-21, wherein each of the discharge stations comprises a control unit for controlling the discharge of articles from the conveyor and data
25 communication means being adapted to communicate data relating to the identity of an article passing from the previous conveyor section to the discharge station from the control unit of the previous conveyor section and to the control unit of the discharge station, the data communicating means further being adapted to communicate data relating to the identity of an article passing from the discharge station to a following conveyor section from
30 the control unit of the discharge station and to the control unit of the following conveyor section.

23. A method according to any of the preceding claims, wherein the trays have an upper surface of a concave shape as viewed in a cross-section perpendicular to the longitudinal
35 direction of the conveyors.

24. A method according to any of the preceding claims, wherein the upper surface of the trays is coated with a friction increasing material.

5 25. A method according to any of the preceding claims, wherein the system comprises a return conveyor for returning empty trays from the at least one discharge station to the at least one loading station.

26. A system for conveying items comprising

- 10 at least one loading station for loading items onto trays,
at least one discharge station for discharging items from the trays,
a first conveyor and a second conveyor for conveying articles, each article
comprising a tray carrying at least one item, said first conveyor being arranged for
conveying articles from the at least one loading station and to an article storage
15 arrangement and said second conveyor being arranged for conveying articles from the
article storage arrangement and to the at least one discharge station,
an article storage arrangement comprising a plurality of storage units in each of
which a plurality of articles may be stored, means for moving articles from the first
conveyor and to each of the plurality of storage units, and means for moving articles from
20 each of the plurality of storage units and to the second conveyor, and
control means for controlling the operation of the conveyor system.

27. A system according to claim 26, wherein substantially each of the storage units of the storage arrangement is designed for permitting a plurality of articles to be disposed aligned

25 in abutting proximity to each other longitudinally along a generally horizontally elongated storage bay, each storage unit comprising a frame defining said storage bay and support means for supporting the articles to be stored in the storage unit.

28. A system according to claim 27, wherein the support means of each of the storage
30 units are arranged slightly downwardly inclined towards a front end in the longitudinal direction of the storage bay of said storage unit so that articles stored in the storage unit will be drawn towards said front end by the force of gravity acting on the articles, each of the storage units further comprises

means for moving the stopping means of said storage unit between a position where the stopping means prevents articles stored in said storage unit from passing the front end of the storage bay of said storage unit and a position where the stopping means allows articles to pass said front end.

15 30. A system according to claim 29, wherein the storage rack comprises
elevating means for moving articles between the at least two horizontal levels,
shifting means for moving articles in a horizontal level, the shifting means being
arranged in a vertical plane substantially parallel to the vertical plane of the front ends of
the storage bays of said plurality of storage units,
20 first transferring means for transferring articles between the elevating means and the
shifting means,
second transferring means for transferring articles between the elevating means and
the first and the second conveyor,
loading means for loading articles from the shifting means into the storage units, and
25 unloading means for unloading articles from the storage units onto the shifting
means,
so that articles may be moved from the first conveyor and to each of the plurality of storage
means arranged in the storage rack articles may be moved from each of the plurality of
storage units arranged in the storage rack and to the second conveyor by means of the
30 elevating means, the shifting means, the first transferring means, the second transferring
means, the loading means, and the unloading means of said storage rack.

31. A system according to any of claims 26-30, wherein each article is labelled with a unique, automatically readable identification mark and the system comprises reading

means for reading the identification marks and producing an output accordingly, the reading means being situated at least at one position along the path of the articles.

32. A system according to claim 31, wherein an identification mark is placed on the tray
5 and the control means comprises a central control unit comprising means for storing and retrieving data concerning the identity of each of the items being conveyed by the system and data concerning the identity of the tray on which each of said items is placed.

33. A system according to any of claims 26-32 comprising a separation unit arranged so
10 that articles are transferred to the separation unit from the first conveyor and articles may be transferred from the separation unit to the second conveyor or to the article storage arrangement, the separation unit comprising means for transferring a given article from the separation unit to either the second conveyor or the article storage arrangement depending on the identity of the article, said means being controlled by the control means for
15 controlling the operation of the conveyor system.

34. A system according to any of claims 26-33, wherein the first and the second conveyors each comprises a plurality of conveyor sections arranged in series, each given conveyor section comprising a control unit and data communication means, data relating to the
20 identity of an article that is passing from the preceding conveyor section being communicated to the given conveyor section from the control unit of the preceding conveyor section to the control unit of the given conveyor section by means of the data communication means of the preceding conveyor section.

35. A system according to claim 33 and 34, wherein the separation unit comprises a control unit and data communication means, the data communication means being adapted to communicate data relating to the identity of an article that is passing from the preceding conveyor section to the separation unit from the control unit of the preceding conveyor section to the control unit of the separation unit, the data communication means further
30 being adapted to communicate data relating to the identity of an article that is passing from the separation unit from the control unit of the separation unit and to either the control unit of the adjacent conveyor section of the second conveyor or to a control unit controlling the article storage arrangement, the control unit of the separation unit being adapted to control the means for transferring a given article from the separation unit to either the second
35 conveyor or the article storage arrangement.

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36. A system according to claim 35, wherein the separation unit comprises data communication means for communication data regarding whether a given article is to be transferred to the article storage arrangement or to the second conveyor from the central control unit and to the control unit of the separation unit.

37. A system according to any of claims 26-36 comprising an X-ray unit for X-ray screening the items conveyed by the system and a diversion unit for receiving rejected articles, said X-ray unit being arranged so that articles pass the X-ray unit when being conveyed by the first conveyor, the X-ray unit comprises means for diverting articles to the diversion unit depending on the result of the screening, the operation of said means and of the X-ray unit being controlled by the control means for controlling the operation of the conveyor system.

38. A system according to any of claims 26-37, wherein each of the discharge stations comprises a control unit for controlling the discharge of articles from the conveyor and data communication means being adapted to communicate data relating to the identity of an article passing from the previous conveyor section to the discharge station from the control unit of the previous conveyor section and to the control unit of the discharge station, the data communicating means further being adapted to communicate data relating to the identity of an article passing from the discharge station to a following conveyor section from the control unit of the discharge station and to the control unit of the following conveyor section.

39. A system according to any of claims 26-38, wherein the trays have an upper surface of a concave shape as viewed in a cross-section perpendicular to the longitudinal direction of the conveyors.

40. A system according to any of claims 26-39, wherein the upper surface of the trays is coated with a friction increasing material.

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41. A system according to any of claims 26-40 and comprising a return conveyor for returning empty trays from the at least one discharge station to the at least one loading station.

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42. A storage rack for storing articles, each article comprising a tray carrying at least one item, comprising

- a plurality of storage units, each storage unit being designed for permitting a plurality of articles to be disposed aligned in abutting proximity to each other longitudinally along a
- 5 generally horizontally elongated storage bay,
- a frame defining said storage bays, and
- support means for supporting the articles to be stored in each of the storage units.

43. A storage rack according to claim 42, wherein the support means of each of the
- 10 storage units are arranged slightly downwardly inclined towards a front end in the longitudinal direction of the storage bay of said storage unit so that articles stored in the storage unit will be drawn towards said front end by the force of gravity acting on the articles, each of the storage units further comprises
- movable stopping means that may be positioned so that said stopping means of said
 - 15 storage unit prevents articles stored in said storage unit from passing the front end of the storage bay of said storage unit, and
 - means for moving the stopping means of said storage unit between a position where the stopping means prevents articles stored in said storage unit from passing the front end of the storage bay of said storage unit and a position where the stopping means allows
 - 20 articles to pass said front end.

44. A storage rack according to claim 42 or 43, wherein the plurality of storage units are arranged in at least two vertically spaced generally horizontal levels, said storage units being arranged so that the longitudinal directions of the storage bays of said plurality of
- 25 storage units are being substantially parallel and so that the front ends of the storage bays of said plurality of storage units are arranged in substantially the same vertical plane.

45. A storage rack according to claim 44 comprising
- elevating means for moving articles between the at least two horizontal levels,
 - 30 shifting means for moving articles in a horizontal level, the shifting means being arranged in a vertical plane substantially parallel to the vertical plane of the front ends of the storage bays of said plurality of storage units,
 - first transferring means for transferring articles between the elevating means and the shifting means,
 - 35 loading means for loading articles from the shifting means into the storage units, and

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unloading means for unloading articles from the storage units onto the shifting means,

so that the articles may be moved to and from each of the plurality of storage units arranged in the storage rack by means of the elevating means, the shifting means, the first
5 transferring means, the loading means and the unloading means of said storage rack.

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